AN INTRODUCTION TO PRESERVATION OF PAINTINGS

O. P. Agrawal
Chemist, National Museum
New Delhi.

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THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA
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DEPARTMENT OF MUSEOLOGY
(Faculty of Fine Arts)
Maharaja Sayajirao University of Baroda
BARODA
1967

Price Rs. 2=50

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OFFICE OF THE DIRECTOR OF MUSEOLOGY
2 FEB 1970
1390
GOVT. OF MADRAS, MADRAS.

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Printed by Ramanlal J. Patel, Manager, The Maharaja Sayajirao University of Baroda Press (Sadhana Press), Near Palace Gate, Palace Road, Baroda, and published by Shri V. H. Bedekar, for the Dept. of Museology, Faculty of Fine Arts, at the Maharaja Sayajirao University of Baroda, Baroda. March, 1967.

FOREWORD

It gives me great pleasure to write this foreword to the eighth book titled "An Introduction to Preservation of Paintings" by Shri O. P. Agrawal in the publication series of the Department of Museology of the Faculty of Fine Arts in the M. S. University of Baroda.

It is a comprehensive study dealing with the composition of paintings, their causes of deterioration and preventive measures. The science of chemical conservation of antiquities and works of art has undergone quite rapid developments in the last few decades and various methods and techniques have been evolved for the protection and preservation of such cultural material. Paintings, no doubt, form an important category of our cultural legacy, for the proper preservation of which no efforts should be spared. The problems of preservation in hot and humid climate like that of our country are typical and the author has succinctly dealt with them as related to paintings in different media.

Shri O. P. Agrawal, Chemist, National Museum, is welknown in the field of painting conservation in India. I am particularly happy to note his long and active association with our Department of Museology where he has delivered series of lectures to the post-graduate Museology students on the subject of his specialization. I am sure this book based on some of his lectures delivered here will be found of great utility and advantage to the students of Museology and would prove to be of general use and interest to all those in the museum profession.

C. S. PATEL
Vice-Chancellor
M. S. University of Baroda.

Baroda-2
10th March, 1967

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INTRODUCTION

Paintings represent one of the most valuable treasures handed down to us from our past. When did man paint his first painting we do not know and what was the shape of that first painting is also not known to us. But we do know that man started using the medium of colour for expressing his inner self from a very early date. The earliest known examples of painting date in India from about two hundred centuries B.C. Since that time paintings are being done for fun, pleasure, self-expression, decoration or sorcery. But to-day only a tiny portion of what must have been created by the artists during this long period of art activity remains. The rest has been lost. Man, although proud of his artistic past, has not shown enough concern for its safety. He is, even to-day, so much taken up by the aesthetic qualities that he seems to have completely forgotten that a painting has a body made of materials that are liable to change. He does not seem to be conscious of the fact that the life of a painting depends upon the reactions of the material with the destructive agencies that are constantly at work. Time spares nobody. The decay of art objects continues even though we may not be noticing it.

What is to be done then if a work of art is to be protected from decay, and protected it must be " for art, although an individual expression of genius, belongs to human history and should be handed down with the greatest care to future generations ? " The only way out is to develop an active consciousness for preservation in the people who are in charge of collections. To-day only a few realise the responsibility that rests upon them for the care of their charge. How are they to carry out their duty towards their collection well if they are not aware of the speed of deterioration and the response of various objects to deterioration ? The need is to propagate, in simple non-scientific language, the knowledge of the various forces of destruction and the precautions to deal with them. The present work does not pretend to be either original or complete. It is but an addition to the earlier efforts of propagation of this knowledge, the practical application alone of which can save the fast perishing heritage of art objects. Every single effort, howsoever small and insignificant it may be, is a step towards the final goal.

It must be impressed again and again that all matter, inside the museum or outside it, is subject to deterioration. Deterioration is a

process, often slow, but inevitable. The appearance of a museum object, as the alteration in it may be apparent only after a good deal of damage has occured, may lead us to conclude that the object is solid and secure and the fact that it is continuously being subjected to the forces of deterioration may escape us altogether. An art object is to give pleasure, not only to the present generation but also to the future and should, therefore, be made to survive till eternity, if possible. This is of course an ideal and probably an impossibility, since we know that no material can escape forever the effect of time and the effect of natural forces. But all the same we also know that the process of deterioration can certainly be slowed and retarded.

The action taken to retard, prevent or stop the effect of ageing is termed preservation. The term preservation should not be confused with the term restoration, which means action taken to correct deterioration or alteration already set in. A better term now universally accepted is "conservation" which includes concepts of both preservation and restoration. Here we shall be concerned only with preservation and not with restoration, the curing treatment, of the paintings. Proficiency in restoration, the curing treatment, can come only as a result of long experience of work on hundreds of paintings under expert supervision. The restorer has to develop within him a sense of judgement that can not be taught, unfortunately, by written word. He has to see and to learn the technique with a guide. Only practice can make him perfect. An account of the restoration techniques has, therefore, been purposely avoided, for a bad restoration may inflict more injury upon the painting than any natural agency.

To understand the problems of preservation of paintings we shall have first to study how a painting is done and what are the materials used. Next in the course of our study will be the nature of the deteriorating forces and how the paintings react to them. Lastly, we shall come to the principles for controlling the deterioration forces. Glossary of the technical terms included at the end will help clarify understanding of the subject.

MATERIALS OF PAINTINGS

Construction of Paintings

Apart from the aesthetic quality of a picture, the picture has a physical form and a physical body. Its form and its body are made of certain substances. The two most essential constituents of a painting are: the support and the paint. There must be a rigid surface that will carry the paint. This surface may be a wooden panel, paper, fabric, metal, leather, rock or plaster. Surfaces that have rigid bodies can be used, and have been used, as carriers for paintings. The other essential constituent of a painting is the paint. The support alone will not be called a painting until the paint is laid upon it. The paint may be only a dry pigment or may be made by mixing the pigment with a binding medium. The chalk writing on a board does not contain any adhesive and its particles are held only loosely, on the rough surface of the board. Since there is no strength in the bond of the chalk and the board it can easily be wiped off by hand. In order to provide a bond between the paint and the support, therefore, pigments are mixed with certain film-forming substances, like glue, wax, oil, gum or starch, that have a property of binding pigments and sticking to the surface of the support. The substances that are mixed with the pigments for the purpose of binding them to the support are termed the binding media.

Then, the supports available for painting are generally not smooth. For execution of fine details in a painting, a smooth surface is required. This smooth surface is obtained by the application of a putty like mixture on the support in a thin layer, and the resulting layer is termed the ground or the priming. The ground also like paint is made of an inert material like chalk or zinc white mixed with a binding medium. It is applied in much the same way as the paint with a brush or knife or spatula.

Some paintings also have protective coatings on their surfaces. These coatings go under the name of varnishes. The varnishes are generally composed of resins—natural or synthetic—dissolved in an organic solvent. The resin should be colourless and should have film forming properties. On application on a painting the solvent evaporates and the resin forms a transparent film on the surface.

Thus, it may be seen that the paintings have a very complex structure. First there is a support, on the support a coating of ground or

priming and then over it the paint. The paint may have been prepared with any type of binding medium. The painting may also have a protective coating of transparent material. The deterioration of painting may, therefore, be the deterioration of any one or more of these constituent layers of a painting. Since all these layers are laid one over the other, if one layer is disturbed in any way the other layers too respond adversely to this disturbance. The cause of a defect noticed at the painting surface may be due to a fault in any one of the several component layers of the painting.

Let us take a concrete case. The flaking of pigments from a wooden panel is a very common observation. This phenomenon may be due to many different causes.
These are:

1. The panel might have warped, in effect to produce a strain on the other layers.

2. The ground may not be adhering well to the wooden support due to loss of its adhesion-power. In this case, the paint will chip off the support along with the ground.

3. The paint itself may have lost its adhering power.

or 4. The varnish may be cracking and thus causing strain to the paint and forcing it to flake.

To make matters worse, the behaviour of all these layers of painting is not similar towards the different deteriorating agencies of matter. A painting will remain safe as long as its layers can adjust to each other and all the layers can be held together in one piece. A museum-man, therefore, has to recognise the various deteriorating agencies and their possible effect upon the matter of which a painting is made. A study of the nature of the materials will be helpful.

Nature of Museum Material

All museum material can be divided, chemically speaking, into two broad categories: (1) inorganic and (2) organic. Metals, stones, ceramics are all inorganic material. Wood, paper, fabrics, leather, bone, ivory, glue, gums are organic material. According to the laws of chemical degradation, it is observed that the organic substances easily deteriorate in comparison to the inorganic material. Materials belonging to the inorganic group, *i.e.* metals, stones, sculptures, ceramics etc. normally do

not present great problem as far as deterioration due to normal agencies is concerned. Unless the environmental conditions are very severe, or some inherent defect is present in the material, not much harm may come to such objects inside a museum by way of natural deterioration. On the other hand, the organic material requires great attention and care for storage and exhibition. Untold harm may fall upon it if such material is left unattended to for a long pericd. For proper preservation, it requries a periodic check to see that no insects are damaging it, the cupboards and show-cases containing the organic material are charged with suitable insecticides, the dampness is not affecting the collection in any way and no mechanical damage is being inflicted upon the objects in handling.

Material of Support for Paintings

For paintings, many different types of supports have been used, the most popular of which are wooden panels, paper and paper-boards and fabrics. Leather, parchment, ivory and metals have been used, but to a lesser degree. The wooden panels are generally ½″ to 3″ thick. Since the wooden planks cannot be obtained very wide, panels are prepared, if required in greater width, by joining two or several planks together. The surface of the panel is smoothed and a thin coat of ground applied before painting. Sometimes a thin fabric is pasted on the board before the ground is laid for painting.

When paper was first used for painting cannot be said with certainty. In medieval periods, it became the most important material for painting, especially the miniatures and the small size paintings. Before its introduction, papyrus and parchment had served the purpose of writing and painting. Fibres of many types of material were used for making paper, the most important of which were cotton, flax, bamboo, grass and some plants. Indian artists prepared paste-boards made by pasting two, three, or more sheets of paper to serve as a thick support. The paste-boards were prepared with unbleached and unsized paper. The surface was thoroughly burnished before and after laying the ground. In general, the picture was not done direct on the board but on a separate paper which was then pasted on the board. To paint with water colours the paper does not require any priming or ground layer.

Cotton cloth seems to have been fairly widely used for the purpose of painting in India since early times. In western countries, linen is the

most common. In China and Japan, the artists have preferred silk. Tibetan and Nepalese Thankas are mostly done on cotton cloth. The fabrics are generally uneven. A suitable material, like a thin coat of gesso or a paint, is used to fill up the weave and make the surface even. The fabric paintings, for purposes of hanging on walls, are either put on stretchers or provided with rods at the bottom and the top for weight as in the cause of scrolls and thankas. The scrolls are generally kept rolled up.

Leather has never been a great favourite as a support for paintings. However, paint has been used to decorate leather objects. In India, leather was used to make painted puppets. On the other hand, parchment and vellum, products of animal skin, have been in common use for writing and illumination. For making leather, animal skin is subjected to a process known as tanning after the hair and the fat of the animal skin are removed, and cleaned. Treatment with tanning solutions makes the skin impervious to water. Parchment is prepared from the inner layer of skin. After the process of washing, liming, dehairing and scraping, the skin is stretched on a frame and scraped again from both the sides. It is then rubbed with hard stone applying chalk or talc on the wet surface. This process gives a very smooth surface for writing or painting.

It is obvious that most of the supports are organic in nature and, therefore, require great attention because of their peculiar construction and complexity of structure.

Nature of Paint

A paint is made by mixing pigments with a substanee having adherent film forming properties. This substance is called the vehicle or carrier of the pigment. The vehicle has to perform two functions in a painting. It functions as a binder of the dry pigment particles into a film and as an adhesive in holding the paint layer to the support to which it is applied. The ability of a paint film to remain attached to the support depends upon several factors including the adhering power and the film forming properties of the medium and the nature of the support. There are several types of binders in use having widely differing properties. Some of the most common binders have been gum, glue, casein, egg white, wax, oil and resinous solutions. A dried film of these substances locks pigment particles inside. The binding principle of all the media is the same *i. e.* the pigment particles are surrounded by the

binding substance that has dried to form an adhering film. The properties of the films, however, differ.

Oil and resinous films are very strong and durable. When the film of these substances is fresh it is flexible and elastic. As time pasees the elasticity is lost and brittleness is imparted. Oil and resinuous solution dry to a solid, glass like substance inside which pigments are encased.

Tempera paint films too are very strong. These films when dried have in their composition less volume of binder than the oil paint has. The bulk of the water with which tempera paint is mixed evaporates completely. This property has imparted one great advantage for the tempera paint. All the faults of paints that are caused due to excess of medium are eliminated. Tempera films are not likely to crack or yellow with age. On the other hand, these are not very flexible and hence suitable only for rigid surfaces. Canvas is not a good support for tempera technique.

Solutions of gum and glue have good adhering and binding properties but do not form strong films when dry. The paint film will, therefore, not be durable unless applied thin.

Every medium has a technique of application of its own. An incorrect technique will result in the failure of paint.

CAUSES OF DETERIORATION

Deteriorating Factors of Musem Material

Before we can understand how to care for paintings we must know what are the various deteriorating factors that affect them. The natural agencies of deterioration are temperature, moisture, atmospheric surroundings and light. In the air are contained soot, dust particles, carbon-dioxide, sulphur dioxide, hydrogen sulphide, all of which have a combined effect upon the material. The number of deteriorating factors, the complexity of their behaviour and the fact that they are present in the atmosphere all the time simultaneously make the natural deterioration a very complicated matter. At best the different factors and their influence can be studied one by one.

The various factors responsible for the deterioration of art-material are of two types: external and internal. External factors mean the factors that take affect from outside the body of the object. They are mainly.

1. Climatic conditions.
2. Atmospheric pollution.
3. Biological growths.
4. Light.
5. Physical factors like the damage in the handling of objects.

By internal factors is meant the damage caused by the nature of the composition of an object.

These agencies of deterioration lead to a gradual degradation of material affecting the appearance and the strength of the object. Depending upon the nature of the material, the resistance offered by it and the intensity and the duration of the deteriorating agencies, the object is subjected to a process which stops only when the decay is complete and the object is destroyed for ever.

1. Effect of Climatic Conditions

Museum climate plays a very important role in the preservation of museum objects. The effect of moisture manifesting itself as shrinking and swelling of wood, consequent damage of paintings on wooden-panels and warping and cracking of wooden sculptures is well-known. Paper in contact with moist air becomes limp, loses its crispness and strength.

High humidity accelerates the growth of biological organisms. Excessive dry atmosphere causes palm leaf to crack and curl. In case of leather while too much moisture leads to bacterial disintegration a very low humidity makes it horny and scaly. Sudden rise or fall of humidity may lead to the setting in of stresses and strains which ultimately help the disintegration of the object.

Climate and Paintings

Wooden-panels very often show a deformation in the plane of the panel. The panel is warped, imparting a concave or crooked look to the painting. The reason of this deformation is the dissimilar behaviour of the painted and the unpainted sides of the wood in humid surroundings. The wood has the property of shrinking when drying. It expands again if it absorbs moisture, which it does when the relative humidity of the atmosphere goes up. In the painted wooden panel the painted side of the panel remains protected from the humidity rise, while the other side absorbs moisture and expands. This gives rise to warping.

Within limits, the warping of a wooden panel in itself may not be dangerous to the painting but for its effect upon the different layers of the painting. The paint, on drying, does not retain the same pliability as when it is fresh. When the wood expands or contracts, in sympathy with the humidity rise or fall in the atmosphere, the paint is unable to conform to this change. The dimensions of the wooden panel are changed whereas the paint remains of the same size. The result is that the paint loses its hold on the wooden support and cleavage occurs. There is a split between the paint layer and the support or the ground and the support. In acute cases blisters are produced and flaking of the paint takes place.

Sometimes the splits or the checks seen in the wooden supports are due to alternate drying and humidification of the wood. The crack in the panel is taken through the paint too. Joints in a board also loosen due to this cause. Alternate drying and humidification results in the production of strain in the wood. All the component members of the board may not be affected in a similar way. Dissimilar expansion and contraction of the panels composing the board will cause the joints to loosen.

Paintings on paper and on paper boards are also affected by humidity. Most Indian miniatures fall in this group of paintings. Indian miniaturists have used glue or gum as binder. These substances give an inflexible paint film. Paper also, like wood, expands and contracts with

the rise and fall of humidity in the atmosphere. The effect on the inflexible paint is disastrous. Flaking of the paint starts and the surface becomes powdery. Curvature is imparted to the paintings. Excessive humidity in the atmosphere makes the paper go limp. Actual contact with the moisture may leave ugly stains on the paper support. Warping seen in the paper boards is also due to the uneven effect of humidity on the different parts of the board. Thick paint, as is generally the case in paintings done in oil or in tempera, cannot remain intact on a warped board.

Fabrics also are affected by the changes in the moisture content of air. Cellulose, the chief constituent of vegetable fabrics like cotton and linen, is hygroscopic in nature. It swells when in contact with water. This swelling and contraction of the fabric supports give rise to a mechanical stress in the painting. The reason of disruption is the rigid and inflexible nature of old paint, whether with oil or any other medium.

Excess moisture has a very deleterious effect on leather just as on any other organic material. Prolonged action decomposes the leather and makes it very supple. Besides high humidity gives impetus to the fungus growth. Very dry conditions result in the dessication of the leather. It loses its suppleness and becomes rigid and horny. Brittleness follows and the flaking of the paint starts.

Parchment, like wood, is a hygroscopic substance and is responsive, to a very great degree, to the rise and fall in the relative humidity of the atmosphere. If exposed to extreme humid conditions for a long time parchment tends to distort and to buckle. The paint starts flaking. Once distortion sets in, special measures have to be taken to eliminate the defect. Such defects of distortions can be cured by stretching the parchment leaf under controlled conditions. For doing this, clips with strings attached are fixed at appropriate distance all round the leaf. The strings pass on a special wooden frame with weights on their ends sufficient to pull the leaf from all sides. Water trays are placed below the parchment not touching it to create humid conditions. In a few days the treatment is complete.

Thus it can be seen that the climate has a profound effect upon the painted objects. They are most sensitive to changes in the conditions of the atmosphere. The first step, therefore, in the preservation of paintings is the control of atmosphere. The urgency and the importance of controlling atmospheric factors have engaged the attention of museum scientists most of all for an effective preservation programme.

Control of Climatic Conditions

The only effective way of fully preventing the deterioration due to climatic conditions is to control the temperature and the humidity of the atmosphere. For evolving a formula of optimum temperature and moisture inside a gallery the factors that should be taken into consideration are:—

1. Response of the different objects to humidity. The stone sculptures, bronzes, ceramics are almost immune. Priority should be given to paintings, wooden objects, and manuscripts.

2. Second factor is the comfort of the visitors. Further, there are certain conditions that should govern a good air-conditioning system in a museum. These conditions are based on the two fundamental principles that the relative humidity must be maintained within reasonable limits and rapid changes of relative humidity must not be allowed.

Content of moisture in the atmosphere is denoted by the term 'relative humidity'. Relative humidity is the ratio between the moisture content in an unit volume of air and the moisture required to saturate the same volume at the same temperature. It is expressed in terms of percentage. O percent relative humidity will mean completely dry air and 100 percent a thoroughly moisture-saturated air. Normally the relative humidity of the atmosphere is somewhere in between. Temperature and relative humidity are interdependent to a great extent. In a closed space, keeping the moisture content the same if temperature is lowered, the relative humidity increases. It may be brought down to a point when the air is no longer able to hold the vapour and so condensation begins. On the other hand, if the temperature rises, moisture content remaining the same, relative humidity goes down and dessication starts. Since this is a point of great importance it may be desirable to illustrate it with an example. Suppose the moisture content in 1 kilogramme of air at a particular time when the temperature is 20°C is 8.69 gm. The amount of moisture required to saturate the same volume of air at 20°C, we know, is 14.61. The relative humidity, therefore, will be $\frac{8.69}{14.61} \times 100 = 60\%$ Now, if the temperature is increased to 40°C, the amount of moisture required to saturate 1 kilogramme of air will be 48.67. The value of relative humidity, the content of moisture remaining the same will now be $\frac{8.69}{48.67} \times 100 = 17\%$. Now, the

value is much less than in the previous case although the content of moisture is not changed.

For preservation of matter, temperature control is important because relative humidity is related to temperature. It is the control of humidity which is the really important factor. This is a point that is often overlooked while planning the museum building or the storage of art objects. The normal air-conditioners or room-conditioners in the market are designed more for the human-comfort than the comfort of the objects. The comfort of the museum objects has a different standard than that of the visitors. For the former, control of relative humidity is much more important than the temperature-control.

Measurement of Relative Humidity

Many different types of instruments are available for measurement of relative humidity. A reliable and simple instrument is the dry and wet bulb thermometer. In the instrument, there are two thermometers. The bulb of one of the thermometers is in contact with air. It records the room temperature. The bulb of the other thermometer is wrapped with a thin muslin cloth, an end of which remains constantly dipped in water. Water evaporters from the cloth. The rate of evaporation will depend upon the moisture-content of the atmosphere. The evaporation of water from the surface of the bulb results in a slight lowering of the temperature-recording of this thermometer. The difference in the readings of the two thermometers indicate, with the help of reference tables for the purpose, the relative humidity of the atmosphere. The thermometer should be saved from air-current for reliable readings. An improvement on this instrument, but based on the same principle, is the whirling hygrometer. In the whirling hygrometer, the two thermometers—dry and wet—are mounted on a board which can be revolved rapidly round a handle provided for the purpose. The thermometers are whirled for about 10 minutes before taking the readings.

Hair-hygrometers can also be used to record relative humidity. Hair, as the other organic substances, increases in size with rise in the relative humidity of the atmosphere and decreases in size if the relative humidity decreases. This increase or decrease in the size of the hair is transferred to a pre-calibrated scale giving relative humidity readings directly.

Instruments are also available that can keep a 24 hours record of temperature and humidity on a graph paper that moves on a revolving

drum. Two needles—one indicating the temperature and the other humidity—rest on the graph, as the drum rotates. The needles fluctuate up and down according to the rise or fall of the temperature and the humidity. These instruments also function on the same principle as the hair hygrometer. The hair hygrometers, though quick in reading, are not as accurate as the dry and wet bulb thermometers. The former have to be regularly calibrated with the help of the latter in order to get reliable data.

Much will depend upon the round the year survey conducted with the help of these instruments. The curator must form an idea of when the humidity is high so that necessary precautions may be taken.

Methods to control humidity

The most effective method of controlling the humidity and the temperature inside buildings is the use of air-conditioners. The air-conditioning plants are very costly and require a planning of the building at the initial stage. Smaller units for individual rooms are also fitted in the windows or other out-lets for air. In these equipments, a certain percentage of fresh air is introduced in the room. The cost of air-conditioning plants, however, is beyond the means of most museums. In the absence of air-conditioning, less costly means will have to be adopted. During the dry summer months, *khas* curtains can be used to introduce extra humidity. Working on the same principle, certain water-evaporators known as water-coolers are available too. Water sprayers that spray water in a fine atomised form in the room have also been found useful in extremely dry conditions. To dehumidify the air during wet months is a greater problem. Use of silica gel, a chemical that absorbs moisture and gives it off again on heating, has been recommended. Sufficient quantities of dry silica gel in containers is kept inside the storage space. An advantage in using silica gel is its ability to lose moisture on heating. The same quantity can be used again and again by dehydrating it in a laboratory oven. But, because of the large quantities required its use is limited to small closed spaces. Dehydrated calcium chloride or fresh lime can also be kept inside closed show cases to absorb moisture. A very practical suggestion is the incorporation by hygroscopic material like carpets, curtains, furnishings, wooden cupboards etc. in the storage room. Such material can absorb humidity when the humidity is high and can again give it off when the conditions are dry. For the same reason, wooden cupboards are safer storage for the paintings than the metallic cupboards.

At least to some extent the paintings can be saved from the effect of the humidity rise and fall by glazing. The back of the painting is covered with thin alkathene film which acts as a moisture barrier. The paintings inside a show case are safer than those exhibited in the open. The reason is that once the atmospheric conditions inside the glazed frame or inside the show case are stabilised changes in the conditions outside do not affect the stability suddenly. During the monsoons, when the relative humidity of the atmosphere reaches to the maximum the paintings should be taken out of the show case or the frame once a month and cleaned with a dry brush. The glasses should be cleaned and dried before the paintings are again put in. During the wet season, there are chances of condensation inside.

It has been observed that the paintings on wooden-panels painted on both sides keep better than the ones painted only on one side. When the paint is only on one side humidity affects from the other side and warping and other stresses set in. Whereas double-sided paintings are reasonably free from this defect. It has, therefore, often been recommended that a paint similar in composition to the original be applied at the back of the painting to counterbalance the two sides.

2. Effect of Biological Agencies

The organic type of museum objects, specially in a tropical wet climate like that of India, are in constant danger of an attack by the biological agents of destruction. These agents are:

1. Micro-organisms like fungi and bacteria.
2. Insects.

Micro-Organisms

Fungi, bacteria and actinomytes belong to a major division of the plant kingdom, *Thallophyta*, and to the sub-division *Mycophyta*. There are certain groups of this division that possess chlorophyll and thus can utilise the solar energy for their growth. On the other hand fungi, bacteria and actinomytes do not have any chlorophyll. These micro-organisms can, therefore, exist only as parasites or saprophytes depending for their growth on the material on which they grow. All organic materials, especially wood, textiles, leather, paper, are good food for fungi and bacteria.

Both fungi and bacteria are concerned in the deterioration of materials. Bacteria are less complex forms of organisms than fungi. Of prime importance are the fungi, the treatment for which also takes care of

the bacteria. The fungi may be divided broadly into two main types: one that affect the strength of the material and the other that do not. The first type of fungi causes the material to deteriorate and the latter type produces undesirable colouration or odour. The latter type of fungi are also referred to as mildew.

The minute spores of fungi find access to the material either from the air or are brought there with some insects. The spores lie dormant if the climatic conditions are not favourable for growth. The conditions most suitable for the growth of fungi are met in the tropical countries with heavy rainfall and high temperature. Relative humidity above 70 per cent is most conducive to the growth of fungi. At above 80 per cent the growth is very rapid. Temperature below 18°C. has been found to restrict the growth of most types of fungi. The growth is most rapid between 25°C and 40°C. Most fungi cannot stand a temperature above 45°C. In India the required conditions for the growth of fungi are often present during the monsoon months of July and August.

The material on which the paintings are generally done—wood, paper, fabric—are easily affected by fungal growth provided suitable atmospheric conditions prevail. Of all the varieties of fungi the most damaging to wood is what is known as dry-rot. The dry-rot fungus makes the wood soft and spongy. Wood decayed by this fungus resembles charred wood, not only in colour, but in appearance too. The affected wood is considerably weakened and coloured. It develops a brownish shade. Then there are fungi that cause no structural damage to the wood but produce stains and discolouration. Many kinds of moulds grow on wood. Usually they appear as greenish black little points or patches here and there.

The deterioration of paper material due to biological agents assumes serious proportions in a country like India where humidity and temperature are high, almost throughout the year. There are scores of species of fungi that attack paper. Paper, besides cellulose, contains impurities that provide an excellent medium for the growth of fungi. There seems to be a correlation between the compositions of paper and their resistance to fungal growth. Thus it has been observed that all-rag paper (about 95% content of cellulose) is more resistant to fungal attack than the other types. Glue and starch, that are used as sizing materials of paper, attract fungus. Fungus and bacteria decompose cellulose. Fabrics are also attacked the same way. Fungi leave green-black spots on the face of the

paper [illegible] which are impossible to remove. Foxing or brown spotting of paper has be[illegible] attributed partly to the attack of fungi.

Control of Micro-organisms

Since high humidity and high temperature accelerate the biological gr[illegible] [illegible]st [illegible]nportance should be given to stabilising the climatic conditions inside a museum. Another important reason for the growth of micro-organisms is lack of ventilation. Bad storage is responsible for most of the fungal attacks. It should be ensured that the paintings are taken out of the storage periodically, cleaned and aired. If any painting has become wet accidentally it should be thoroughly dried before it is stored again.

It is not always possible to have a controlled atmosphere in the museum. In that case a suitable fungicide should be used with the paintings. A number of organic and inorganic compounds have been tested for us[illegible] [illegible]ngicides. The choice of a fungicide will depend upon many factors A[illegible] [illegible]icide, while toxic to fungi and bacteria, should be non-toxic to human beings. For use of museum material like paintings it should [illegible] colourless too. It must not affect the pigments or the medium in any way. The fungicides are used either in solution or in gaseous form. For keeping in the storage cupboards a fumigant type of fungicide is required. Thymol serves the purpose well. Some of the effective fungicides for wo[illegible] that are used in solution of water are 4% sodium fluoride, 3% silic[illegible] fluoride, and 1% mercuric chloride. 5% solution of thymol in alcohol [illegible]an be used as a fungicide on the back of a painting. 5% solution of paranitrophenol shows good fungicidal activity. Tri, tetra and penta chlorophenols are also toxic to fungi at even low concentrations.

The sterilization of the atmosphere of the storage room by spraying a 10% solution of thymol in alcohol has been recommended to keep a check on the growth of spores present in a store-room where the humidity cannot be brought lower than 75% during the monsoons. After the spray, the room may be kept closed for atleast 24 hours to allow the thymol vapour to have full effect.

Insects

Powder-post-beetles, moths, cockroaches, silver-fish and termites are some of the insects that attack and damage the museum material. To have a check on their development and growth the use of toxic insecticides is essential. For the saf[illegible] maintenance and preservation of organic objects, of vegetable as well as a[illegible]imal origin, special precautions are to be observed.

page from an insect damaged illustrated manuscript

The most dangerous type of insects for wood are wood-borer beetles and termites. Termites are more active in the architectural woods that are in contact with the ground. The first sign of an attack of the wood-borers is given by the appearance of small holes caused by the insects at the surface of the panel. White flour-like powder falls out of these holes and gets deposited on the ground near the object. This will mean that the insects are active and alive. Immediate fumigation in an air-tight chamber, preferably with vacuum arrangement is required. Since most fumigants are deadly poisonous and highly explosive, only qualified laboratories, under the supervision of trained staff should carry out such work.

Some of the most common insects harmful to the paper are silver fish, termites, beetles, book-lice and cockroaches. The silver fish damages the paint surface and the sizing material. The termites can bring destruction to the entire collection in no time. Worms and beetles tunnel the paper thoroughly.

Control of Insects

Much of the destruction caused by insects can be prevented. Generally insect attack is a result of neglect. If a system of periodic inspection of collections can be adopted in the museum, insects will have no chance of development. Before an object is added to the collection it should be free of insects and their larvae. If required, fumigation may be done before putting it into store.

Protection is also imparted by treating the painting with a toxic substance. The toxic chemical can also be sprayed over the wooden walls of the storage cupboards. The cupboards can be made of *deodar* wood which has insect repelling properties. The insecticides should be used to prevent the attack of insects and not waiting till there is an actual outbreak. Some of the common insecticides are DDT, mercuric chloride, pyrethrum powder, para-di-chloro-benzene, napthalene, etc. DDT is used both in a powder form or spray. The powder is placed at the floor of the storage cupboards. DDT solution is sprayed on the walls and the sides of the wooden storage cupboards. 5% solution of mercuric chloride in water may be used at the back of wooden panels to immunise them from insect attack. Regular supply of fumigant type repellants like naphthalene and para-di-chloro-benzene crystals are kept in the upper-most shelf of the cupboard as its fumes are heavier than the air.

Fumigation

If any actual outbreak of insects or fungus is detected the object is sent for sterilisation and fumigation. Fumigation of the art-objects is done with the help of special air-tight chambers inside which the fumigant is kept. The chamber is made air-tight and the objects are kept inside for about 2 weeks. Thymol fumigation is done in special chambers made of wood. At the bottom of the chamber there is an opening. Thymol crystals contained in glass bowls are kept over the opening. Underneath there is an arrangement for heating with 100 W heating bulb. The crystals melt and the thymol fumes are given off. In about half an hour the whole chamber is charged, when the heating is cut off.

For sterilisation more toxic chemicals like carbon-tetra-chloride, carbon-di-sulphide, hydrogen cynide gas, methyl bromide etc are used. All these chemicals are highly toxic and dangerous to life. It is better to leave their use in the hands of those who are qualified to use them,

Summary

The precautions for the control of insects and fungus may be summarised as follows:

1. Before adding any new collection to the permanent storage or display in the galleries it should be a practice to check for presence, if any, of the insects. As a safety measure the collection should invariably be fumigated and cleaned before adding to the main collection.

2. Storage cupboards and display show cases should constantly remain charged with insecticides. Some of these are para-di-chloro-benzene, naphthalene balls, DDT powder, gammaxene. DDT power could be sprinkled in shelves of the cupboard in such a way that it does not come in direct contact with the material. Para-di-chloro-benzene and the naphthalene balls are of fumigant type and by far the best.

3. Storage cupboards or boxes to keep organic objects should be pre-treated with toxic agents to combat the woodborers and termites.

4. Damage caused to the paper paintings by the insects and the microbial agents is often irreparable. The paper paintings and manuscripts should frequently be taken out of the storage boexs or shelves and dusted and cleaned.

5. The boxes and shelves may also be dusted and cleaned periodically.

6. As soon as an insect attack is detected the infected paintings should be sent for disinfectation.

7. The store-rooms for organic material should be well-ventilated and reasonably dry.

8, To deal with the invasion of insects more toxic insecticide is to be used. If required, fumigation may be done.

9. A periodic check is kept on all material for likely attack of insects.

3. Effect of Light on Paintings

Light, which is a form of energy, is a major factor in the deterioration of museum objects including paintings. The damaging effect of light on the paintings is two-fold, first the chemical deterioration of the material of the painting and secondly the fading of colours and also often the change in the nature of the paint-medium and the varnish. Light starts certain chemical reactions in the material and causes deterioration, termed as photo-chemical deterioration.

What Is Light?

Light is a form of energy radiated by the different sources of illumination. It is not homogeneous in nature but is composed of several types of radiations. Sun-light for example, does not consist only of the radiations with the aid of which the objects become visible. The visible-radiation or the visible light is only a tiny portion of the whole complex. In the light complex, ultra-violet rays, infra-red rays and the other invisible rays are also present, besides the visible light. The percentage composition of these radiations in a particular light depends upon the type of the source emitting the light. The light from one source may contain a greater percentage of ultra-violet rays than the other. The effect of the light on the matter, obviously, is a combined effect of all these constituent radiations of light. The deterioration suffered by an object will, thus, depend upon the nature of the light source and upon the response of the material of that object to the different constituents of light.

Effect on the supports

The support of a painting is mostly organic in nature. The organic material is composed of groups of molecules which are inter-linked to each other to form bigger molecules. This is known as polymerization. The strength of the organic material depends upon the extent of poly-

merization present. The reverse, that is the breakdown of these bigger units into smaller ones, known as depolymerization, signifies disintegration. Light, through the process of photo-chemical action, brings about the decay or the destruction of the bigger units of polymerised molecules resulting in the breakdown of the structure of the material. The fibres of the textiles on which the paintings are done may, thus, be affected by light and may lose their strength. The cellulose, a main constituent of the textiles, is oxidised, leading to degradation by exposure to light. It is fairly agreed now that this type of degradation of cellulose is caused by that portion of the light which is known as the ultra-violet rays. In fact, the process of this photo-chemical decay is still not understood fully, although a great deal of research work has been carried out, first, to determine the mechanism of photo-chemical breakdown, and secondly, to find suitable methods of prevention of this decay. It is, however, indicated that the photo-chemical degradation is apparently due to oxidation of cellulose by oxygen in the atmosphere, the reaction being accelerated by water vapour. The photo-chemical reaction is necessarily preceded by the absorption of ultra-violet light.

Similarly, paper is affected by exposure to light. The paper also deteriorates due to oxidation. Good quality papers, such as all-rag papers, are more resistant to the deteriorating effect of light than the low quality papers are. Short wave-length radiations tend to make the paper brittle and yellow. The presence of rosin, glue, alum, iron or other such substances has a strong bearing on light degradation.

Effect of Paint

Light changes the nature of the binding medium and also causes the colours to fade. The vehicles have a varying reaction to exposure of light. Some, like glue and casein, are affected, but to a lesser degree. Light can cause deterioration of starch and size. Lack of light can cause the linseed oil film to darken, becoming yellow and eventually brown. This reaction is more or less reversible. The darkened paintings can again be bleached by exposure to light. Resinuous varnishes on the other hand are darkened. Varnish films are oxdised and become less soluble in the solvents.

The other effect of light on the paint is the fading of colours. Water-colours soon become lowered in tone by over-exposure to light. Dyed textiles fade if they remain illuminated for long. This type of action is best illustrated by paintings, some portions of which have remained cover-

ed for some reason. The covered portions always show bright and fresh colours. Fading of colours, it is agreed, is caused by the absorbed visible portion of light and to some extent also by the ultra-violet portion.

Nature of the Light Sources

Since degradation of the paintings is caused both by the visible and the invisible portions of the light it becomes necessary to study the types of light sources and their characteristics. The sources of light are either natural or artificial. The natural source of light is sun-light or day-light. Artificial lights are mainly of two types : (1) incandescent and (2) fluorescent. The incandescent lamp is generally in a bulb form in which a tungsten filament is heated to emit light. The principle of fluorescent light is different. In the fluorescent tube certain radiations are emitted by the impact of an electron upon mercury vapour, with which the tube is filled. These radiations, mostly in the ultra-violet region, strike the walls of the tube which is pre-coated with a chemical that fluoresces, *i.e.* emits visible light, when such radiations fall upon it. Such sources of light derive their names from this phenomenon. Fluorescent tubes consume less electrical energy, are economical and give more light. Since that light is given by the impact of ultura-violet rays, a fair portion of ultra-violet radiations is always present in this light.

Authorities now agree that the day-light is most dangerous to the material and the incandescent the least. The fluorescent tubes are also dangerous but less that the day-light. It is now recognised that the fluorescent tubes are not as hazardous as once they were supposed to be. With proper use of filters these can be completely safe.

Prevention of the effect of light

A special commission of the International Council of Museums (ICOM) examined the problem of modern artificial light sources and their potential danger value to museum-objects. The deterioration due to light, according to the findings of the Commission, depends upon :

1. The intensity of the irradiation.
2. The time of exposure.
3. The special character of the radiations emitted by the light source.
4. The capacity of the object receiving the light to absorb and be affected by the radiant energy.

Paintings as discussed earlier are highly susceptible to light and should, therefore, never be exposed to high intensity illumination. Levels

of illumination of about 50 lux (5 foot candles) have been widely and successfully employed for the displayed materials, which are particularly sensitive. The intensity of day-light coming from windows can be controlled by shades, plastic louvres and curtains. It can also be controlled by the use of diffusing glasses on the windows.

Total exposure of an object is equivalent to the intensity the time of exposure. The time of exposure of paintings to light should, therefore, be minimised as far as possible. One way to achieve it is to have only rotating exhibitions of delicate and important painted or dyed material. Further, the showcases can be fitted with light-proof curtains that are drawn, when there are no visitors, to cover the objects inside. These are opened only when a visitor wishes to see the paintings, or else the illuminating light is switched off the moment it is not required.

We have already seen that the photochemical degradation of material and fading of colour is due both to the visible light radiations and ultra-violet radiations. If by some process the ultra-violet radiations can be cut off it will be a positive step towards the prevention of photo-chemical degradation. The visible light portion of the spectrum is necessary for viewing an object but the ultra-violet radiations are invisible and are not required.

Special ultra-violet filters may be fitted to eliminate the unnecessary and potentially harmful ultra-violet radiations. A simple method to cut off ultra-violet rays is to reflect the light from painted surface containing titanium white or zinc white paints. Incandescent light is practically devoid of ultra-violet radiations and does not present any problem. The fluorescent light and the day-light, however, whenever used, must be guarded against by suitable use of ultra-violet filters or absorbers.

Summary

Summing up on the basis of the above it can be said that

1. General illumination level in the gallaries should never be appreciably higher than that required for normal viewing. It may be wise to have a rotating exhibition of delicate and important painted or dyed material.

2. In the galleries indirect lighting should be preferred to direct one.

3. Daylight will be suitable, from the preservation point of view, for galleries exhibiting sculptures and other inorganic material,

4. The distribution of light on the exhibits should be as uniform as possible.

5. The time of exposure of paintings to light should be restricted to a minimum.

6. It is preferable to use translucent or transparent glass panes in front of a light source.

4. Effect of Atmospheric Pollution

Sulphur-dioxide, hydrogen sulphide, carbon oxides, soot, dust particles suspended in air can be sources of great danger to the exhibits. Sulphur-dioxide in contact with moisture yields sulphurous acid and finally sulphuric acid. Carbon-dioxide, similarly, combines with water to yield carbonic acid. These acids, formed in howsoever small a quantity, are bound to have an effect on the paper, leather, textiles and even metals. Silver in contact with hydrogen sulphide tarnishes very soon. Air in the areas near the sea is laden with salt spray which has a deleterious effect upon all types of museum objects. Even stone sculptures and metal objects are affected by the sea-air containing suspended salts. Dust particles, suspended in air, form a layer on the painting surface, having not only an abrasive effect on the painting but also a chemical effect on the paint-material. This dust hazard is all the more pronounced in a dry desert area like Rajasthan in our country.

In the absence of air-conditioning and purification of air the only practical solution to combat the hazards of the atmospheric pollution seems to be glazing of pictures. Glass, however, has a serious disadvantage in as much as it gives rise to reflections and thereby prevents the picture from being properly seen. This disadvantage can be reduced by having the picture slightly inclined. While providing a frame and glass for the picture, attention must be paid to the design of the rebate of the frame. The rebate should be so designed that it cannot damage the edges of the picture. Pieces of cork or rubber placed between the painting and the rebate may prove helpful. The wood of the frame may be pre-treated with insecticides.

Also the glass should be of a good quality. It should not remain in direct contact with the painting. It has been observed that long contact with the glass may result in the paint's adhering to the glass surface. It may be impossible to save the paint from total destruction in case of such an accident. The glass can be kept away from the painting by placing

strips of thin masonite at the edges between the painting and the glass. The small paper paintings may be kept under the widow cut mount.

During cleaning of the exhibition hall, care should be taken to raise as little dust as possible. Vacuum cleaners are a help for this purpose. After vacuum cleaning, the floor may be swept with damp rags wrapped over brushes.

5. Damage Due to Mechanical Factors

So far as we have discussed the deterioration of paintings that give rise to certain chemical or biological reactions in the structure of the painting. The structure of the paintings may also be disturbed due to certain other factors like accidents, damage by a pointed tool, mishandling, wrong method of carrying, fire etc. This type of damage caused by mechanical means is purely physical in nature. The reuslt may be very disastrous. The main cause is only a little carelessness. Probably more harm is done to the objects through ignorant human hands than through any other agency. We would have often seen writing and scratches done by the visitors on the walls of important monuments and on wall-paintings. To stop this sort of damage, what is required is to inculcate a sense of discipline in the people—a real love for the art objects. It must be publicised properly that such writings are not paying the visitor anything but are definitely defacing and damaging the art piece.

Have we ever thought about the mechanical damage that the objects suffer after their entry into the museum? In a museum we cannot plead ignorance. As museum-men we must know how to keep art-objects, how to handle them, how to clean them, for, the art-objects are not only valuable but in many cases irreplaceable. We would have often seen the paintings stored in a heap, their painting sides in direct contact with other paintings. Paintings are also stored in envelopes. Often no care is taken that the edges are being damaged. Some paint is being lost through abrasion with each other.

Again large paintings on paper on or cloth are stored rolled like a scroll. Creases appear in the paper due to this practice and the paint flakes off. Sometimes paintings on paper are kept folded. We shall find that the painting is damaged at the fold-line.

Then the enthusiastic care-taker of the paintings wants to keep his paintings clean and free of dirt. What can happen to a painting within a short period, that any one can imagine, if rough cloth is used for dusting

Effect of rolling a scroll

instead of using a soft brush. Every time the surface is dusted by the rough cloth some minute part of the paint is lost. The same action repeated again and again will be multiplied in no time. To dust the large paintings in the exhibition hall even some force is used to remove the dirt with a cloth.

To avoid this type of damage we may study what are the risks involved and accordingly steps may be taken to guard against those risks. It should be made a rule that the paintings are not moved or handled frequently. There are more chances of accidents if the painting is moved again and again. Photographic reproductions of the paintings in the reserve collection should be available for inspection, selection etc. so that handling is kept to a minimum.

By providing frame and glass to a picture the chances of accidental damage are much reduced.

Fabric paintings should not remain unstretched. Proper stretchers to keep the paintings flat must be provided. The stretcher is made of four pieces of wood fitted together with double mortices at the mitered corners. For a very large stretcher, cross pieces are fitted in the middle to give extra strength to the stretcher. The corners of the stretcher are so made that the individual pieces can be forced apart by wedges. The wedges are placed in pairs into the corners and carefully hammered in to keep the canvas taut. The wood of the stretchers should be good quality. It should be checked, off and on, that the stretchers are secure in place.

Fabric paintings having paint of any thickness should never be rolled. The oxidised oil film cracks or crumples when it is rolled up, and cracks when it is unrolled. Rolling old pictures may result in the cracking of paint and even canvas. Scrolls where the paint is only a thin wash and generally does not have an independent identity will not be damaged by rolling. But there is a technique of rolling the scrolls. No crease or fold should be allowed to enter when rolling a scroll. The right amount of pressure should be applied evenly and lightly to roll it. Folding will certainly damage a scroll on cloth.

Undue vibrations in moving a fabric painting from one place to the other may cause cracks to develop in the paint. The back of the painting should never be struck hard. Cracks may develop or even the fabric may be torn.

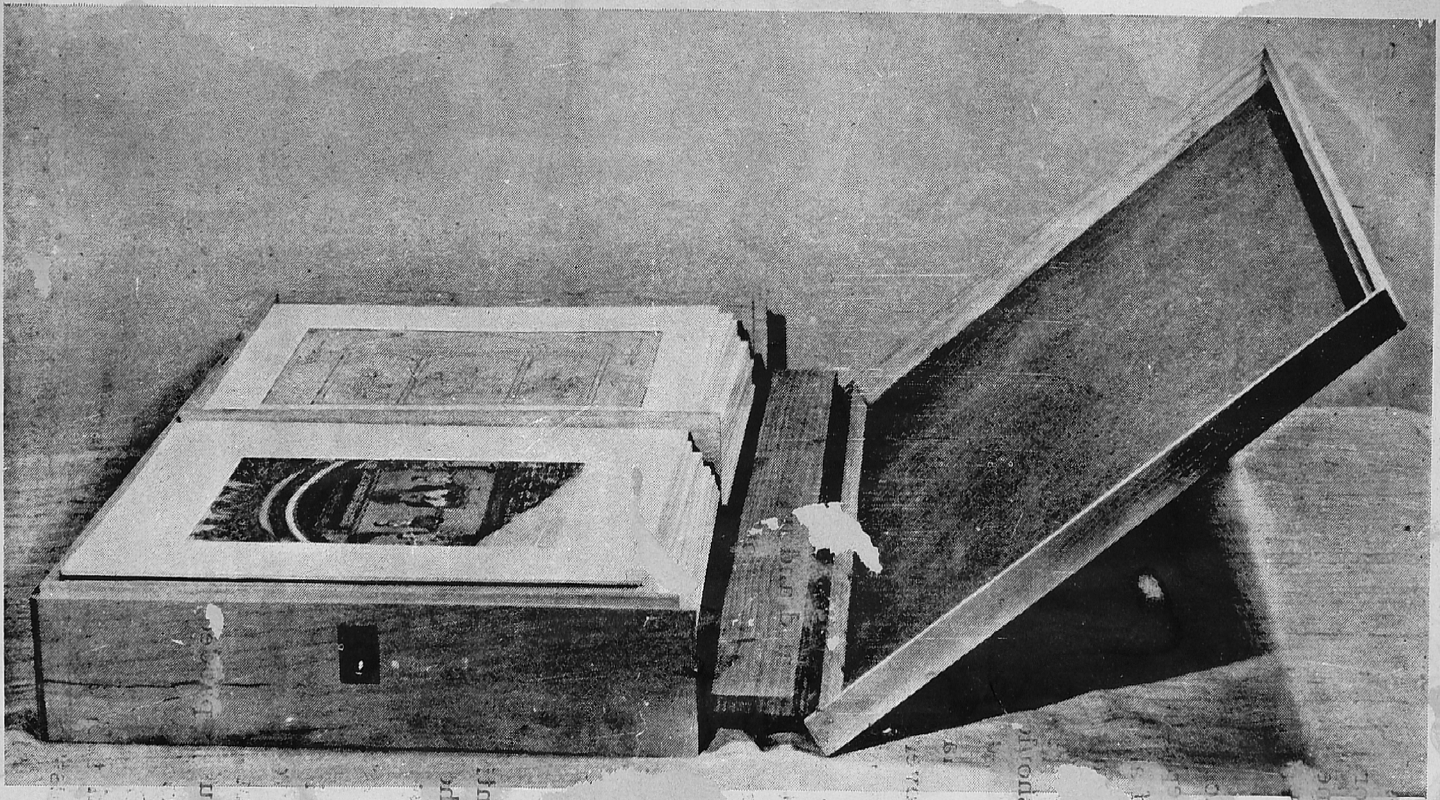
[illegible]tings on paper should be handled with great care. The first [illegible] preserving paintings on paper is to keep the support rigid. [illegible]ver be allowed to bend. The edges of the painting should not [illegible] to be damaged. The painting should not be kept folded. The surfaces should not be allowed to be abraded, either by rubbing [illegible]h other or against any other hard or rough surface. The best [illegible] the small paintings on paper is to put them in a window-type [illegible]ll rag mount board. The painting is hinged to the board only [illegible]hree places with strips of tissue paper using maida paste. (For [illegible]of paste and specification of mount board see Appendix.) [illegible]ging [illegible]d never be done with cheap adhesive tapes or scotch tape. The entire painting should not be pasted on a thick mat. To save the painting surface from abrasion and accidental scratches a thin tissue paper is placed over the surface of the painting. The paintings should never be [illegible]d one over the other without tissue paper in between.

The painting betwe[illegible]e mats should invariably be kept flat and [illegible]rizontal. Unframe[illegible] unmounted paintings should always be lifted by t[illegible] corners. Hands sh[illegible]uld not be allowed to come in contact with the s[illegible]o carry the paintings from one place to the other special port-[illegible]be used.

[illegible]nting should never be allowed to fold or to crease. Deteriorated paper [illegible]nferior quality paper should never come in contact with the painting.

P[illegible]tings are also damaged while dusting. Dusting of the painting [illegible]ould be done only with a soft flat brush taking care that no paint particle is scraped off. It is usually a very delicate business and should never be entrusted to inexperienced junior staff members.

[illegible] paintings should never be allowed to be moved by one person. At least two persons, with one hand steadying the painting at the top and with [illegible] other supporting at the bottom, should carry big paintings. It is [illegible]se a [illegible], rolling trolley for transport of paintings. In fact, th[illegible]annot be very hard and fast rules for the handling of museum pieces. Before handling a painting, all possible risks must be foreseen and considered thoroughly. If there is any loose paint or flaked paint the matter must immediately be reported to the proper authority and action taken before the painting is moved.



Painting-storage-box in [illegible] National Museum, New Delhi

Wooden cabinet to store painting-storage-boxes.
National Museum, New Delhi

Storage of Paintings

Paintings in the reserve collection of a museum are to be placed in a store room. Besides the climatic and biological deteriorating factors, the mechanical factors must also be taken into account before planning the storage. The two fundamental principles for the plan of painting-storage are: (1) the need to save the painting from damage and (2) the ease of consulting the paintings from time to time. Safety of the paintings does not mean that the store is a dead place. As already mentioned earlier, the fabric paintings should never be left without their frames and should never be rolled up. Rolling of a canvas may save space but will be disastrous for the paint. Such a canvas when straightened out shows splits cracks in the paint.

The paintings should not be stored with their painted sides touching each other. This may cause abrasion of paint. Not many paintings can be stored against the walls alone. Storage of big paintings in a horizontal position is also not wise. Some museums have storage cupboards with spacers that allow the paintings to be kept in a vertical position. This system, however, does not allow the paintings to be consulted conveniently. Some other modern museums have equipped their store-rooms with parallel vertical metal frames fitted with a grill, on which a number of paintings may be hung with hooks. The grills are fairly near each other and are fitted with castors that slide along rails in the floor and at the top with pulleys that move along an iron bar across the ceiling. Each grill can be slid out for inspection of the pictures.

The paintings on rigid and heavy supports can be stored in special racks with padded floors and sides.

For storage of mounted paper pictures, special boxes known as the solander boxes are used. The sizes of the boxes are standardised. These boxes can be constructed easily in the museum workshop or by private cabinet makers. The material of construction is wood and masonite, both pretreated with insecticide solutions. *Deodar* wood is known to have insect repelling properties which may be used for making the boxes and cabinet. There is a lid of the box that fit well with a flange to keep out dust as far as possible. Front of the box opens when the lid is up. The mounted paintings can be slid in one by one from the front. There is less likelyhood of the damage of edges in such storage. The chances of accidental damage are also minimised considerably. The boxes are stored in cabinets

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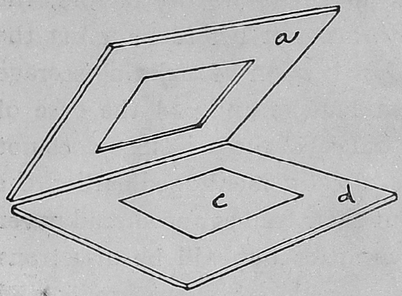
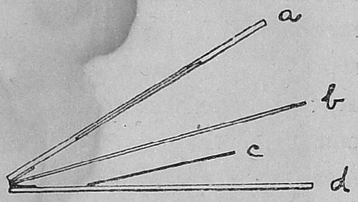
constructed for the purpose. It is necessary that the wood used in the preparation of boxes and cabinets is always seasoned.





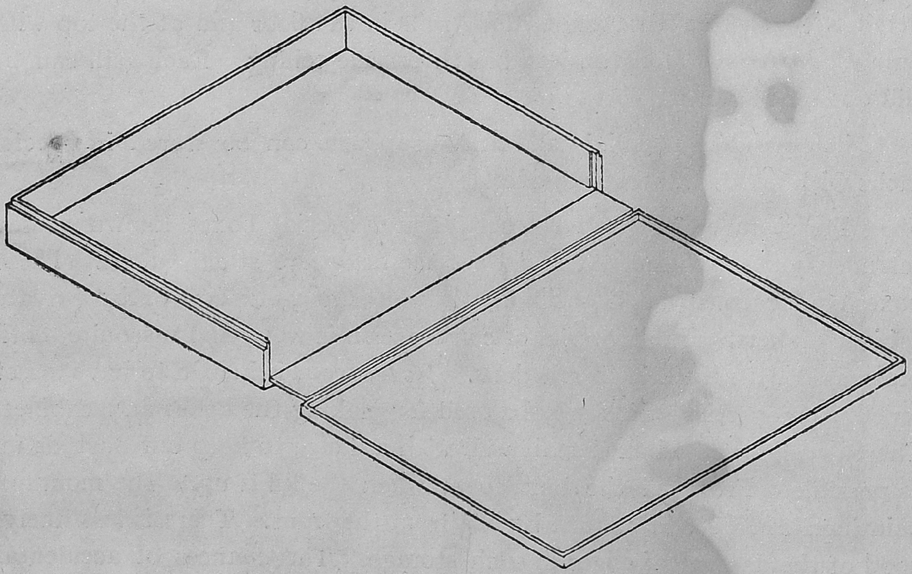
Window cut-mount for small paper paintings:

(a) Window cut-mount of all-rag board.

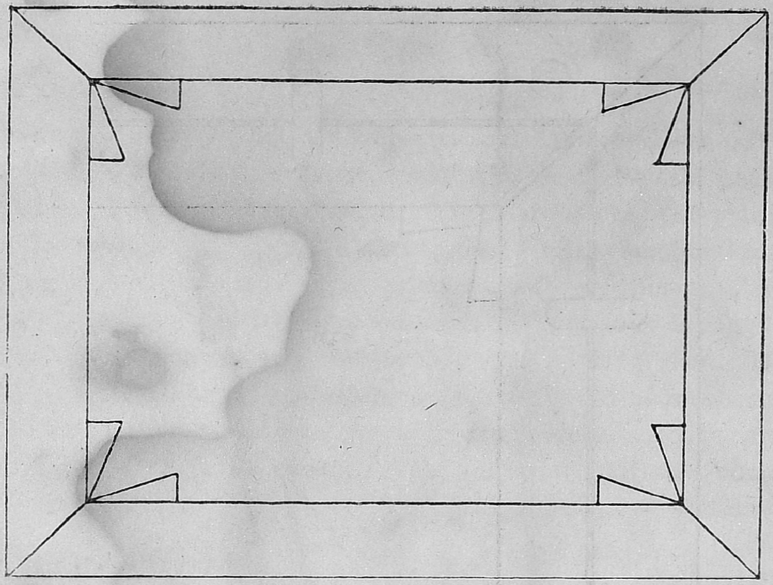
(b) Tissue paper.

(c) Painting hinged to support.

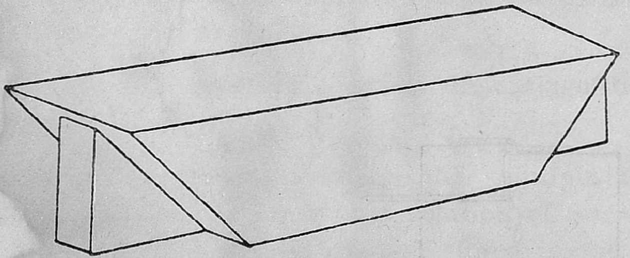
(d) All-rag board support.

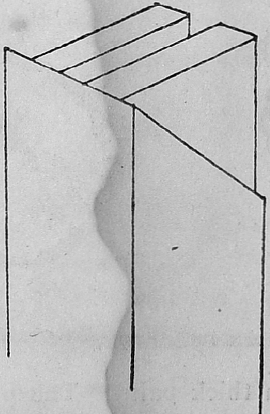


Box of wood and masonite board for storage of paintings

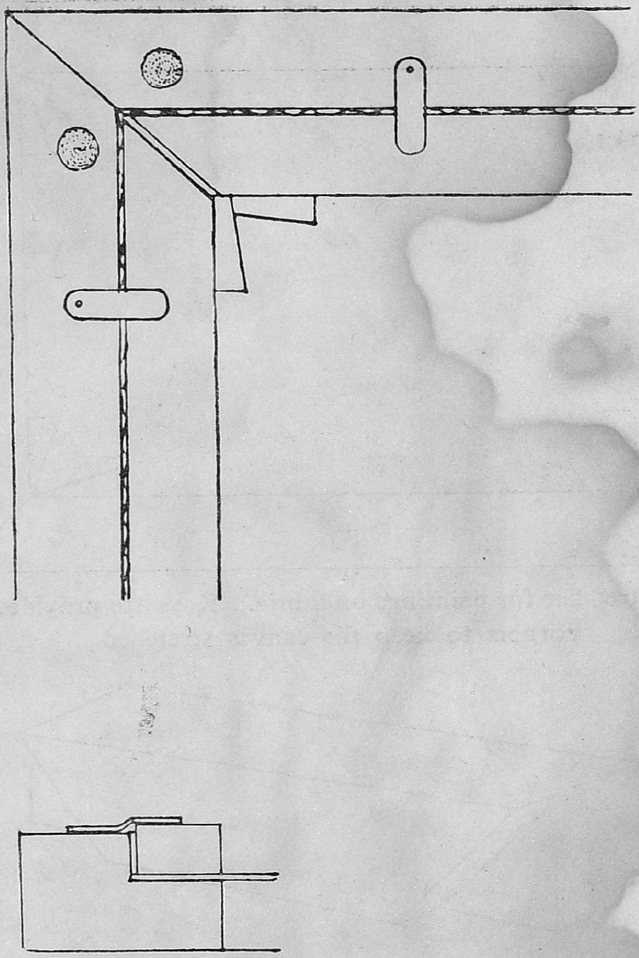


Wooden stretcher for paintings on fabric. Keys are provided at the corners to keep the canvas stretched.





Corner of a wooden stretcher.



Metal clips are used to attach the stretcher to the frame.

Effect of rolling a canvas-painting with thick paint. The paint gets detached.

Precautions for Packing:

Sometimes the paintings are to be packed for transport outside the museum. The principles of precautions to be observed while packing are the same as for storage and exhibition. These are saving the picture from the climatic changes, biological attacks, dust, vibrations and accidents. The packing case may be made dust-proof. Some weather-proof material like polythene sheet should always be used. Vibrations during packing can be avoided by using screws only to close the packing box. Hammering should be avoided as far as possible. There should be no space around the picture which can allow it to move inside loosely. All vacant space must be filled up with resilient packing material that can cushion the painting from all sides.

Fire-Service in the Museum

Fire in a museum can be very devastating. The museum-staff should receive a compulsory training in fire-fighting. Buckets of sand and water should be ready all the time in appropriate places. This is not enough. Fire extinguishers should be available too.

Mainly, there are four types of chemical fire-extinguishers available in the market:

(1) Soda-acid type—These work on the principle that the gas evolved by the action of sulphuric acid on a solution of Soda-bicarbonate creates sufficient pressure to eject the solution stored in the extinguisher out of it with a force in the form of a jet. These are specially suitable for places with a scarcity of water.

(2) Foam extinguishers—This is a development of soda-acid type. In this apparatus, a chemical foam is ejected which creates a sort of blanket on the burning object and thus suffocates the fire. Aluminium-sulphate solution along with the solution of sodium-bicarbonate produces a foam in which some ingredient is added to toughen the film.

(3) Carbon-dioxide extinguisher—In this a jet of carbon-dioxide is ejected which creates an atmosphere thereby fire remains unfed with oxygen. In this no solution comes out and is dry type.

(4) Carbon-tetra-chloride (C.T.C.)—A jet of carbon-tetra-chloride is ejected in this case. This type is specially useful for electric fire carbon-tetra-chloride being non-conductor of electricity.

Of these four types of hand fire-extinguishers for the museum having organic material like paper, textiles, paintings, wooden objects etc. which are likely to be spoilt by the wet, slightly acidic solutions the most suited is the dry carbon-dioxide type. We cannot think of any other type being used in galleries or rooms where rare organic material is exhibited or stored. Carbon-dioxide apparatus, however, has to be used at a range closer than the other types. Therefore, for places having materials like stones etc. foam type can be used convenientiy, but for paintings they would be most dangerous. We should not forget that readiness against fire is the only safety device. It can be one of the most destructive agencies of art material.

General Rules for Care of Paintings:

1. Paintings are very delicate and, therefore, must be handled with care.
2. Paintings on stretcher must be moved or carried from one place to the other one by one.
3. Before sending th painting out or moving, it must be examined for presence of damage. The damage must be reported to the conservation department.
4. There must be a practice of periodic inspection of paintings. At that time all the paintings on stretchers should be made taut, frames cleaned and damages, if any, examined.
5. A painting should never be carried by one hand. One hand must be under the frame and the other at the side.
6. Protect the surface from abrasion.
7. Hands should not be allowed to come in contact with the painted surface.
8. Prints, drawings, small paintings on paper must always be kept inside mats.
9. Scotch tape or other type of commercial adhesive tapes are very injurious to paper.
10. Dust the paintings with very soft brush only.
11. A painting must never be sent out with glass on.

6. The Internal Factors of Deterioration

Behaviour of Paint

Our discussion so far has been limited to the causes of deterioration of paintings due to factors working from outside. The extent of damage

Cracks in this painting developed due to the use of weak material

due to these factors will also depend upon the properties of the materials and how the materials have been used for painting. If the technique of painting was faulty various deterioration agencies will have more success in affecting the paint. Further, there are certain reactions natural to the paint over which there cannot be any control. An example is the shrinkage of oil paint. With age the oil film shrinks and fine thin cracks are formed in the paint layer. There is an early crack formation frequently occurring within a few hours of painting due to faulty technique. Paint layers that are less flexible than the under layers will crack soon. There are three main reasons for their being harder than the under layer. The over-painting may contain less oil than the under painting, it may be made with a binding medium considerably more brittle than the underpainting or it may be containing more turpentine than required.

Oil paint containing too much drier tends to be more brittle and cracky type. Over a smooth, glossy surface like metal or glass, since there is no good adhesion between the paint and the support, oil paint shows early cracks. In fact cracking, cleavage, blisters and flaking, may be called the successive stages of the same phenomenon of failure of paint-adhesion with the support either because of defective support or defective paint.

In paintings on paper, using water soluble media as in most of the Indian miniatures, certain pigments, like verdigris, are known to have a very damaging effect upon the support. The portions of paper painted with this pigment are easily charred browned and eventually totally lost. In paintings on paper another great enemy is presence of acidity. In paper acidity could come through many sources. It could have been introduced at the time of manufacture or later in preparing the paper for painting. Even small quantities of acid tend to break the fibres of cellulose, the material of which paper is made, resulting in loss of strength.

It would thus be seen that the deterioration of paintings is a complex phenomenon. It is slow and is probably not being noticed but is having its toll every minute of the day. Only constant efforts can minimise the effects of the damaging agencies, natural or accidental.

APPENDIX A

SPECIFICATIONS OF BOARD FOR MOUNTING THE PAINTINGS

1. The board must be flat. It should have a smooth surface and be opaque.
2. It should be prepared from new rag fibres.
3. It should neither contain any acid components like alum nor any hygroscopic substance.
4. The board must be strong, rigid and stiff.
5. The basic weight of the board should be nearly 1000 G.S.M.

APPENDIX B

PREPARATION OF PASTE

Formula

Maida 20 grms	(maida is prepared by sieving fine wheat fluor through a cloth piece)
Water 200 c.c.	
Sodium Arsenite. 50 mgs.	
saffrol 1 c.c.	

Preparation

Taking small quantities of *maida* and requisite quantity of water in a double boiling pot a mixture is prepared. The mixture is stirred vigorously taking care that nodules of *maida* are not formed. In this way the full quantity of maida is mixed with water. After this powdered sodium arsenite is added and stirred well. The boiling pot is put on fire and the paste cooked. The paste is allowed to froth for a few minutes. After it is well-cooked it is cooled and squeezed through a muslin cloth. The requisite quantity of saffrol is added and stirred well. The paste keeps well in the normal Indian climate for about 2 days.

GLOSSARY:

ABRASION: 1. Action of rubbing.
2. Damage due to above action.

ACCRETION: A deposit on the surface.

ATTACHING: Applying a support to the back of painting.

AUXILIARY SUPPORT: An extra support, for example, in the relined canvas.

BACKING: Attaching an auxiliary support; An auxiliary support.

BLEACHING: To lighten the colour of a dark surface.

BLISTER: A bulge in the paint layer.

CHECK: A partial separation in a wooden support.

CLEANING: To remove surface accretions, old varnish and repaint etc. from the face of painting.

CLEAVAGE: A separation parallel to the surface between the paint and the ground or ground and the support.

COATING: A layer of paint or a varnish applied to the surface of a painting.

COCKLING: Appearance of a crumpled shape of a paper painting.

COMPLEX: Composed of two or more kinds of materials.

COMPOSITE SUPPORT: One that consists of two or more layers of support.

CRACK: A separation in any layer of a painting.

CRAQUELURE: Cracks in the ground, paint or varnish.

CRADLE: An auxiliary support for a painting on wood. It is intended to prevent the panel from warping without restricting its expansion and contraction.

DESIGN: Outline or the pattern of the painting.

DISINFECTANT: A chemical that kills damaging biological growths.

FILLING: To fill material into the holes, cracks and other lacunae of a paint layer.

FLAKING: Loss of paint.

FATTENING: Correction of a deformation in the support or in the paint layers.

FOXING: Brown spots in a paper support.

GROUND: To cover the irregularities of the support a layer of paint is applied on it. It may consist of only one layer or a number of layers.

IMPREGNATING: Infusing with a solution.

LINING: Attaching a canvas or paper secondary support to a fabric or paper painting.

LOCAL: To do only with a portion of the painting.

MEDIUM: Vehicle with which the pigments are mixed to prepare the paint. It holds the pigment particles together.

MOUNT: Any secondary support of rigid material like paper-board or composite board.

MOUNTING: Attaching the painting to a rigid secondary support.

OVERCLEANING: To continue cleaning operations beyond what is needed.

OVERPAINT: Any repainting that covers the original paint.

PAINT: Paint is composed of pigments + vehicle.

PASTE: An adhesive.

PRIMARY SUPPORT: The material that actually carries the paint layer. The ground is an intermediary applied to smoothen the support.

PRIMING: A very thin layer of paint applied on the ground to receive the painting.

REINFORCE: To provide extra strength by infusion or by attaching a secondary support.

RELINING: To fix a fabric with an adhesive to the back of a fabric support.

RELINING MIXTURE: The adhesive used to reline a painting. Generally it is a mixture of wax and a resin or a glue adhesive.

REPAINT: To paint the lost portions of a painting.

RETOUCHING : Repainting.

RIP : A separation at a seam in a fabric support.

SECONDARY SUPPORT : A support that is attached to the main support for strength.

SIZING : Coating on paper or fabric to give strength to the fibres.

SPLIT : Separation in a rigid support.

STAIN : It is an accretion which becomes one body with the material of the painting.

STERILIZING : To disinfect.

SUPPORT : The physical structure that supports or carries the ground or paint film of a picture.

SURFACE COATING : A varnish.

TEAR : A separation in a fabric or paper support.

TRANSFER : To replace the support of a painting.

VEHICLE : Medium of the paint.

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